



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/US96/11737 <b>(22) International Filing Date:</b> 15 July 1996 (15.07.96)  <b>(30) Priority Data:</b> 502,953                      17 July 1995 (17.07.95)                      US  <b>(71) Applicant:</b> EXXON CHEMICAL PATENTS INC. [US/US]; 1900 East Linden Avenue, P.O. Box 710, Linden, NJ 07036 (US).  <b>(72) Inventors:</b> BLOCH, Ricardo, Alfredo; 1532 Ashbrook Drive, Scotch Plains, NJ 07076 (US). DEVINE, Maryann; 34 James Street, Lincroft, NJ 07738 (US). RYER, Jack; 61 Jensen Street, East Brunswick, NJ 08816 (US). WATTS, Raymond, Frederick; 7 Oxford Lane, Long Valley, NJ 07853 (US).  <b>(74) Agent:</b> SHATYNSKI, Theodore, J.; Exxon Chemical Company, 1900 East Linden Avenue, P.O. Box 710, Linden, NJ 07036 (US).	<b>(81) Designated States:</b> AU, CA, JP, SG, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>	
<b>(54) Title:</b> POWER TRANSMITTING FLUIDS WITH IMPROVED RESISTANCE TO FOAMING  <b>(57) Abstract</b>  This invention concerns power transmitting fluids, particularly automatic transmission fluids, containing synthetic or partially synthetic lubricating oils that have superior foam suppression properties due to the presence of a fluorosilicone antifoamant.		

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POWER TRANSMITTING FLUIDS  
WITH IMPROVED RESISTANCE TO FOAMING

5

BACKGROUND OF THE INVENTION

This invention relates to compositions and methods of improving the properties of power transmitting fluids, particularly to obtaining automatic transmission fluids with superior resistance to foaming.

The continuing advances made by automobile manufacturers to improve vehicle performance and reliability place increased demands on the lubricants used in the vehicle engine and drive train. This is especially true of automatic transmission fluids (ATF's). Over the last ten years changing specifications have reduced the allowable low temperature viscosities for ATF's as well as increased the requirements for oxidation resistance and wear protection. These more severe requirements resulted in numerous changes in additive technology as well as caused reformulation of ATF's to incorporate more oxidatively stable base oils with improved low temperature viscosities. These trends have resulted in formulation of partially synthetic or fully synthetic to meet these more severe requirements.

One aspect of ATF performance that is often overlooked is foam suppression. This includes the fluid's resistance to foam formation as well as its ability to break or dissipate foam, if formed. Many of the changes in fluid composition and transmission design have aggravated this problem and heightened the need for improved antifoamants. Fluids formulated with less viscous, more volatile base stocks, required for improved low temperature performance, tend to produce more foam, and more stable foams than ATF's formulated with the heavier base oils of previous generations. As vehicle transmissions become smaller and operate at higher temperatures and pressures, the transmissions tend to generate more foam. Many of the rotating elements in the transmission are now operating at speeds greater than 5,000 rpm, which provides an enormous potential for increased foam generation through churning and aeration.

We have now found that a particular class of antifoamants described generally as fluorosilicones (e.g., perfluorinated polyalkylsiloxanes) are very effective and superior antifoamants for power transmitting fluids, especially partially or fully synthetic ATF's. These antifoamants are effective in treating  
5 foam generated by air entrainment or by physical churning, and they are effective at very low concentrations in the finished fluid.

### SUMMARY OF THE INVENTION

10

This invention relates to a power transmitting fluid comprising:

- (a) a synthetic lubricating oil;
- 15 (b) a fluorosilicone antifoamant; and
- (c) optionally, a natural lubricating oil.

This invention also concerns a method for providing power transmitting  
20 fluids having superior foam suppression.

A particular advantage of this invention is that the compositions disclosed pass the ATF foam suppression requirements of both the Ford Motor Company and General Motors Corporation.

25

### DETAILED DESCRIPTION OF THE INVENTION

This invention describes the use of fluorinated silicones of varying  
30 molecular weights to suppress foam formation in power transmitting fluids, especially automatic transmission fluids. Examples of other types of power transmitting fluids included within the scope of this invention are gear oils, hydraulic fluids, heavy duty hydraulic fluids, industrial oils, power steering fluids, pump oils, tractor fluids, universal tractor fluids and the like. These  
35 power transmitting fluids can be formulated with a variety of performance additives and in a variety of base oils.

### Lubricating Oils

Lubricating oils contemplated for use in this invention are derived from  
5 synthetic lubricating oils or mixtures of synthetic lubricating oils and natural  
lubricating oils. Suitable lubricating oils include base stocks obtained by  
isomerization of synthetic wax and slack wax, as well as base stocks  
produced by hydrocracking (rather than solvent extracting) the aromatic and  
polar components of the crude. In general, both the natural and synthetic  
10 lubricating oils will each have a kinematic viscosities ranging from about 1 to  
about 40 mm<sup>2</sup>/s (cSt) at 100°C, although typical applications will require each  
oil to have a viscosity ranging from about 2 to about 8 mm<sup>2</sup>/s (cSt) at 100°C.

Synthetic lubricating oils include hydrocarbon oils and halo-substituted  
15 hydrocarbon oils such as oligomerized, polymerized, and interpolymerized  
olefins [e.g., polybutylenes, polypropylenes, propylene, isobutylene  
copolymers, chlorinated polyactenes, poly(1-hexenes), poly(1-octenes), poly-  
(1-decenes), etc., and mixtures thereof]; alkylbenzenes [e.g., dodecyl-  
benzenes, tetradecylbenzenes, dinonyl-benzenes, di(2-ethylhexyl)benzene,  
20 etc.]; polyphenyls [e.g., biphenyls, terphenyls, alkylated polyphenyls, etc.];  
and alkylated diphenyl ethers, alkylated diphenyl sulfides, as well as their  
derivatives, analogs, and homologs thereof, and the like. The preferred oils  
from this class of synthetic oils are oligomers of  $\alpha$ -olefins, particularly  
oligomers of 1-decene.

25 Synthetic lubricating oils also include alkylene oxide polymers,  
interpolymers, copolymers, and derivatives thereof where the terminal  
hydroxyl groups have been modified by esterification, etherification, etc. This  
class of synthetic oils is exemplified by polyoxyalkylene polymers prepared by  
30 polymerization of ethylene oxide or propylene oxide; the alkyl and aryl ethers  
of these polyoxyalkylene polymers (e.g., methyl-polyisopropylene glycol ether  
having an average molecular weight of 1000, diphenyl ether of polypropylene  
glycol having a molecular weight of 1000 - 1500); and mono- and poly-  
carboxylic esters thereof (e.g., the acetic acid esters, mixed C<sub>3</sub>-C<sub>8</sub> fatty acid  
35 esters, and C<sub>12</sub> oxo acid diester of tetraethylene glycol).

Another suitable class of synthetic lubricating oils comprises the esters of dicarboxylic acids (e.g., phthalic acid, succinic acid, alkyl succinic acids and alkenyl succinic acids, maleic acid, azelaic acid, suberic acid, sebacic acid, fumaric acid, adipic acid, linoleic acid dimer, malonic acid, alkylmalonic acids, alkenyl malonic acids, etc.) with a variety of alcohols (e.g., butyl alcohol, hexyl alcohol, dodecyl alcohol, 2-ethylhexyl alcohol, ethylene glycol, diethylene glycol monoethers, propylene glycol, etc.). Specific examples of these esters include dibutyl adipate, di(2-ethylhexyl) sebacate, di-n-hexyl fumarate, dioctyl sebacate, diisooctyl azelate, diisodecyl azelate, dioctyl isothalate, didecyl phthalate, dieicosyl sebacate, the 2-ethylhexyl diester of linoleic acid dimer, and the complex ester formed by reacting one mole of sebacic acid with two moles of tetraethylene glycol and two moles of 2-ethylhexanoic acid, and the like. A preferred type of oil from this class of synthetic oils are adipates of C<sub>4</sub> to C<sub>12</sub> alcohols.

15

Esters useful as synthetic lubricating oils also include those made from C<sub>5</sub> to C<sub>12</sub> monocarboxylic acids and polyols and polyol ethers such as neopentyl glycol, trimethylolpropane pentaerythritol, dipentaerythritol, tripentaerythritol, and the like.

20

Silicon-based oils (such as the polyalkyl-, polyaryl-, polyalkoxy-, or polyaryloxy-siloxane oils and silicate oils) comprise another useful class of synthetic lubricating oils. These oils include tetra-ethyl silicate, tetraisopropyl silicate, tetra-(2-ethylhexyl) silicate, tetra-(4-methyl-2-ethylhexyl) silicate, tetra-(p-tert-butylphenyl) silicate, hexa-(4-methyl-2-pentoxo)-disiloxane, poly(methyl)-siloxanes and poly(methylphenyl) siloxanes, and the like. Other synthetic lubricating oils include liquid esters of phosphorus-containing acids (e.g., tricresyl phosphate, trioctyl phosphate, and diethyl ester of decylphosphonic acid), polymeric tetra-hydrofurans, poly- $\alpha$ -olefins, and the like.

30

Natural lubricating oils include animal oils, vegetable oils (e.g., castor oil and lard oil), petroleum oils, mineral oils, and oils derived from coal or shale. The preferred natural lubricating oil is mineral oil.

35

The mineral oils useful in this invention include all common mineral oil base stocks. This would include oils that are naphthenic or paraffinic in

chemical structure. The oils may be refined by conventional methodology using acid, alkali, and clay or other agents such as aluminum chloride, or they may be extracted oils produced, for example, by solvent extraction with solvents such as phenol, sulfur dioxide, furfural, dichloroethyl ether, etc.

5 They may also be hydrotreated or hydrofined, dewaxed by chilling or by catalytic processing, or hydrocracked. The mineral oil may be produced from natural crude sources or be composed of isomerized wax materials or residues of other refining processes.

10 Typically the mineral oils will have kinematic viscosities of from 2.0 to 8.0 mm<sup>2</sup>/s (cSt) at 100°C. The preferred mineral oils have kinematic viscosities of from 2 to 6 mm<sup>2</sup>/s (cSt), and most preferred are those mineral oils with viscosities of 3 to 5 mm<sup>2</sup>/s (cSt) at 100°C.

15 When the power transmitting fluid is a mixture of synthetic lubricating oil and natural lubricating oil (i.e., partially synthetic), the fluid will contain 1 to 80 weight percent, preferably from about 10 to 75 weight percent, and most preferably from about 10 to about 50 weight percent synthetic lubricating oil.

20 The lubricating oils may be derived from refined, rerefined oils, or mixtures thereof. Unrefined oils are obtained directly from a natural source or synthetic source (e.g., coal, shale, or tar sands bitumen) without further purification or treatment. Examples of unrefined oils include a shale oil obtained directly from a retorting operation, a petroleum oil obtained directly

25 from distillation, or an ester oil obtained directly from an esterification process, each of which is then used without further treatment. Refined oils are similar to the unrefined oils except that refined oils have been treated in one or more purification steps to improve one or more properties. Suitable purification techniques include distillation, hydrotreating, dewaxing, solvent

30 extraction, acid or base extraction, filtration, and percolation, all of which are known to those skilled in the art. Rerefined oils are obtained by treating used oils in processes similar to those used to obtain the refined oils. These rerefined oils are also known as reclaimed or reprocessed oils and are often additionally processed by techniques for removal of spent additives and oil

35 breakdown products.

### Antifoamants

Not all antifoamants are capable of providing the superior foam suppression as are the compositions of this invention. Two conventional antifoamants that do not provide the foam suppression of this invention are polysiloxanes and polyacrylates, and are referred to as dispersible and soluble antifoamants, respectively. The siloxane type antifoamants are hydrocarbyl silicone oils, typically polydimethyl siloxanes with varying molecular weights. These silicone fluids are characterized by their viscosities, which range from about 10,000 to about 60,000 centipoise (cP) at 25°C. Silicone type antifoamants do not dissolve in lubricating oils, but are dispersed in the oil as fine droplets. Typical treat rates in the finished lubricating oils are from 5 to 100 ppm. A well known polydimethylsiloxane antifoamant is manufactured by Dow Corning Company and sold as DC-200.

The polyacrylate type antifoamants are polymers or copolymers containing acrylic acids, acrylic esters, methacrylic acids or methacrylic esters in the backbone. These acrylic groups are used to attach sidechains of varying lengths which give the materials their surface activity and, thus, their performance as antifoamants. The polyacrylate type antifoamants are soluble in the lubricating oil, and are therefore called soluble antifoamants. They are typically used at concentrations of 500 to 5,000 ppm in the finished oil. A well known additive of this type is DF-283 sold by R.T. Vanderbilt Company.

In contrast, the antifoamants of this invention are described as fluorosilicones, which are typically polymers or copolymers of perfluorinated alkyl siloxanes. A common monomer in these fluorosilicones is 3,3,3-trifluoropropylmethyl siloxane. The fluorosilicones are polymerized to various molecular weights and are characterized by their viscosities at 25°C. Typical fluorosilicones have viscosities from about 150 to about 10,000, preferably from about 200 to about 5,000, and more preferably from about 200 to about 500 mm<sup>2</sup>/s (cSt) at 25°C. The most preferred fluorosilicone for use in this invention is poly(3,3,3-trifluoropropylmethylsiloxane), polymerized to have a 25°C viscosity of about 300 mm<sup>2</sup>/s (cSt). One commercial fluorosilicone satisfying these requirements is FS 1265, 300 mm<sup>2</sup>/s (cSt), made and sold by the Dow Corning Company. FS 1265 contributes from 1 to 15 ppm of



lemental silicon when FS 1265 is present in a fluid at a concentration ranging from approximately 5 to 50 ppm.

The fluorosilicone antifoamant may be added to the lubricating oil by a variety of methods including direct dispersion, dilution in a "carrier" solvent, or pre-dispersion in an additive package that is subsequently dissolved in the lubricating oil. Treat rates of the fluorosilicones based on active ingredient, are no greater than 100 ppm in the finished fluid. Preferably, the treat rate is less than 50 ppm and, most preferably, ranges from 10 to 25 ppm.

Other additives known in the art may be present in the power transmitting fluid including dispersants, antiwear agents, antioxidants, corrosion inhibitors, detergents, extreme pressure additives, friction modifiers, and the like. They are typically disclosed in, for example, "Lubricant Additives" by C. V. Smalheer and R. Kennedy Smith, 1967, pp. 1-11 and U.S. Patent 4,105,571.

Representative amounts of these additives are summarized as follows:

<u>Additive</u>	<u>(Broad) Wt. %</u>	<u>(Preferred) Wt. %</u>
Corrosion Inhibitor	0.01 - 3	0.02 - 1
Antioxidants	0.01 - 5	0.2 - 3
Dispersants	0.10 - 10	2 - 5
Friction Modifiers	0.01 - 5	0.1 - 3
Detergents	0.01 - 6	0.01 - 3
Antiwear Agents	0.001- 5	0.2 - 3
Seal Swellants	0.1 - 8	0.5 - 5

Suitable dispersants include hydrocarbyl succinimides, hydrocarbyl succinamides, mixed ester/amides of hydrocarbyl-substituted succinic acid, hydroxyesters of hydrocarbyl-substituted succinic acid, and Mannich condensation products of hydrocarbyl-substituted phenols, formaldehyde and polyamines. Mixtures of such dispersants can also be used.

The preferred dispersants are the alkenyl succinimides. These include acyclic hydrocarbyl substituted succinimides formed with various amines or amine derivatives such as are widely disclosed in the patent literature. Use of alkenyl succinimides which have been treated with an inorganic acid of phosphorus (or an anhydride thereof) and a boronating agent are also

suitable for use in the compositions of this invention as they are much more compatible with elastomeric seals made from such substances as fluoro-elastomers and silicon-containing elastomers. Polyisobutenyl succinimides formed from polyisobutenyl succinic anhydride and an alkylene polyamine such as triethylene tetramine or tetraethylene pentamine wherein the polyisobutenyl substituent is derived from polyisobutene having a number average molecular weight in the range of 500 to 5000 (preferably 800 to 2500) are particularly suitable. Dispersants may be post-treated by any reagents known to one skilled in the art. (see, e.g., U.S. Pat. Nos. 3,254,025, 3,502,677, and 4,857,214).

Suitable antioxidants are amine-type and phenolic antioxidants. Examples of the amine-type antioxidants include phenyl alpha naphthylamine, phenyl beta naphthylamine, diphenylamine, bis-alkylated diphenyl amines (e.g., p,p'-bis(alkylphenyl)amines wherein the alkyl groups contain from 8 to 12 carbon atoms each). Phenolic antioxidants include sterically hindered phenols (e.g., 2,6-di-tert-butylphenol, 4-methyl-2,6-di-tert-butylphenol, etc.) and bis-phenols (e.g., 4,4'-methylenebis(2,6-di-tert-butylphenol), etc.) and the like.

Suitable friction modifiers are composed of two distinct parts, a polar head group and an oleophilic tail group. The polar head groups cause the molecule to be adsorbed onto the friction surfaces. These groups can consist of but not be limited to: amines, mono and diethoxylated amines, carboxylic acids, amides, imides, alcohols, phenols, thiols, sulfonic acids, phosphites, phosphates, esters and combinations thereof. The oleophilic groups are typically alkyl groups, normally linear alkyl. They range in carbon number from C<sub>8</sub> to C<sub>30</sub>, preferably C<sub>12</sub> to C<sub>20</sub>. They may be saturated or unsaturated, they may contain hetero atoms such as N or S as long as they do not adversely effect their function as a friction modifier.

Examples of friction modifiers suitable for use in this invention are: oleamide, tallow amine, diethoxylated tallow amine, N,N-bis(2-hydroxyethyl)-octadecyl amine, N,N-bis(2-hydroxyethyl)-stearyl oxypropylamine, oleic acid, N-2-hydroxyethyl,N-(N',N'-bis(2-hydroxyethyl)ethylamin)-stearylamine, the diamide produced from isostearic acid and tetraethylene pentamine, and the like.

The additive concentrates of this invention will contain the fluorosilicone antifoamant and other desired additives in a natural and/or synthetic lubricating oil, in relative proportions such that by adding the concentrate to a larger amount of synthetic or mixture of a suitable natural and synthetic oil, the resulting fluid will contain each of the ingredients in the desired concentration. Thus, the concentrate may contain a synthetic oil as the lubricating oil if the desired final composition contains a lesser amount of synthetic oil relative to the natural oil. The concentrate typically will contain between 25 to 100, preferably from 65 to 95, most preferably from 75 to 90 weight percent of the antifoamant with other desired additives, and synthetic or natural/synthetic (partial synthetic) lubricating oil.

The following examples are given as specific illustrations of the claimed invention. It should be understood, however, that the invention is not limited to the specific details set forth in the examples. All parts and percentages are by weight unless otherwise specified.

In these examples, two foam tests were used to evaluate the foam control capabilities of automatic transmission fluids. The first test is the ASTM D-892 test as modified by Ford Motor Company for inclusion in their MERCON® Automatic Transmission Fluid Specification for Service, dated September 1, 1992 (Section 3.9). In this test, the fluid is aerated in a tall graduated cylinder using a fine diffuser suspended in a column of ATF maintained at a certain test temperature. The test has 4 distinct 5 minute aeration sequences of varying temperature and air flow rates. At the end of each aeration sequence, the volume of foam is reported in milliliters (ml's) and reported again at the end of a 1 minute settling period. The data is given in the format 50/0, which means 50 ml's of foam present after aeration, and none present after 1 minute of settling. Ford requires that at no time there be more than 100 ml's of foam, and that after the 1 minute settling there is no visible foam remaining. Therefore, to pass a fluid must have a result of less than 100/0.

The second foam test is defined in the General Motors DEXRON®-III Specification, GM-6297M, April 1993, Appendix A. The GM test uses a pump and impeller to aerate and churn the fluid. The test is first run at 95°C and

imeters (mm's). The apparatus is then  
 again reported in mm's, as well as the  
 collapse after stopping the agitation. GM  
 95°C, that no more than 5 mm of foam be  
 present, if present at 135°C, collapses in less

atic automatic transmission fluids were  
 shown in Table 1. Each fluid contained  
 package having conventional amounts of  
 additives, antiwear agents, friction modifiers, and  
 detergents. Each formulation also contained varying  
 components for comparison: (1) a polydimethyl  
 siloxane (PDMS) at 25°C from Dow Corning Company;  
 from R.T. Vanderbilt Company; and (3) a  
 mineral oil (MO) at 25°C from Dow Corning  
 and two different types of natural lubricating oil  
 solvent extracted neutral oil from Exxon ( $\approx 3.1$   
 cSt) and a deep dewaxed base stocks  
 ( $2/s$  (cSt) at 100°C;  $80 N \approx 3.4 \text{ mm}^2/s$  (cSt)  
 contained varying amounts of a mixture of two  
 giving a kinematic viscosity of approximately 4  
 cSt at 100°C.

Blends were tested by both the Ford and  
 results of this testing are also shown in Table 1,  
 ADED type indicating a failing result. This  
 hexane based antifoamant (DC-200 12,500)  
 the GM test than the polymethacrylate,  
 and 2 show a particular problem with the  
 results. In the GM test, increasing treatment rate of  
 compared to Blend 1) gives better results at  
 2 passes. However, in Blend 2, the same  
 poorer results in the fourth sequence of the  
 treatment causes the borderline Blend 1 to

actually fail the test. The same concentration effect can be seen in Blends 7 and 8 containing the Petro-Canada base stock. The polydimethyl siloxane based antifoamants are very poor in controlling foam in Sequence 4 of the Ford test. None of the fluids treated with DC-200 (Blends 1, 2, 7 and 8) passed both foam tests.

The acrylate based antifoamant, DF-283, is better at controlling foam in the Ford test, especially in Sequence 4. However, it has very poor control of foam at 93°C in the GM test. Every blend made using the DF-283 (Blends 3, 4, 9, and 10) fail the GM foam test at 93°C. It is also clear from Blends 3 and 4 that increasing the concentration of DF-283 leads to poorer results in the GM test at 135°C. None of the blends treated with the DF-283 acrylate based anti-foamant passed both foam tests.

In contrast, the blends treated with the fluorosilicone, FS 1265, (Blends 5, 6, 11, and 12) give essentially no foam, in any test, at any condition. Blends 5, 6, 11, and 12 are the only blends that pass both foam tests.

## EXAMPLE 2

Three fully synthetic ATF's were blended and treated with the same three antifoamants described in Example 1 above. The compositions of the fluids are given in Table 2. Table 2 also contains the results of the foam testing performed by both the GM and Ford methods, failing results are again shown in **BOLD-FACED/SHADED** type. The results obtained show the superiority of the fluorosilicone antifoamant when compared to those obtained using either of the conventional antifoamants.

The performance of the three antifoamants in the fully synthetic ATF's was analogous to their performance in the partially synthetic fluids. Blend 13 in Table 2, the fluid treated with the polydimethyl siloxane, DC-200, again performed very poorly in the Ford test, failing Sequences 2 and 4. Blend 13 passed the General Motors requirements easily.

Blend 14 contained the polymethacrylates antifoamant, DF-283. Although Blend 14 passed Sequences 2 and 4 of the Ford test, it failed

Sequences 1 and 3. Blend 14 completely failed the General Motors foam test.

5 Blend 15, which was treated with the fluorosilicone based antifoamant of the invention, FS 1265, passed all of the requirements of both the Ford and General Motors test, giving no observable foam in any sequence of either test. This clearly demonstrates the superiority of the fluorosilicone based antifoamants when compared to either type of conventional antifoamant.

10 The principles, preferred embodiments, and modes of operation of the present invention have been described in the foregoing specification. The invention which is intended to be protected herein, however, is not to be construed as limited to the particular forms disclosed, since these are to be regarded as illustrative rather than restrictive. Variations and changes may  
15 be made by those skilled in the art without departing from the spirit of the invention.



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Table 2					
FULLY SYNTHETIC ATF'S					
BLENDS:	13	14	15		
Additive Package	8.00	8.00	8.00		
PAO-4	77.00	77.00	77.00		L
Di-isooctyl adipate	14.00	14.00	14.00		I
TLA 5012	1.00	1.00	1.00		M
ANTI-FOAMANT, PPM FLUID					I
DC-200 12,500 *	16				T
VANLUBE DF-283 **	.	80	.		S
DOW CORNING FS 1265 ***	.	.	18		
TEST RESULTS					
FORD METHOD					
Seq. 1, Vol., ml's	0/0	40/20	0/0		100/0
Seq. 2, Vol., ml's	25/7	0/0	0/0		100/0
Seq. 3, Vol., ml's	0/0	40/23	0/0		100/0
Seq. 4, Vol., ml's	25/11	0/0	0/0		100/0
GM METHOD					
95 C, mm (Foam Height)	0	5	0		0
135 C, mm (Foam Height)	0	9	0		5
135 C, sec. (Collapse Time)	****	4	**		15
* DC-200 is a registered trademark of Dow Corning Company					
** VANLUBE is a registered trademark of R.T. Vanderbilt Company					
*** FS1265 is a registered trademark of Dow Corning Company					
**** No collapse time measurable as no foam was formed.					



**CLAIMS:**

1. A power transmitting fluid comprising:
  - (a) a synthetic lubricating oil;
  - (b) a fluorosilicone antifoamant; and,
  - (c) optionally, a natural lubricating oil.
2. The composition of claim 1 where the synthetic oil is a poly- $\alpha$ -olefin, monoester, diester, polyolester, or mixtures thereof.
3. The composition of claim 2, where the natural lubricating oil is a mineral oil.
4. The composition of claim 3, where the fluid is an automatic transmission fluid.
5. The composition of claim 4 further comprising a borated or non-borated succinimide dispersant, a phenolic or amine antioxidant, and a friction modifier such that the sum of the dispersant, antioxidant, and friction modifier is from 2.0 to 11.0 weight percent of the composition.
6. The composition of claim 1, where the antifoamant is present in an amount no greater than 100 ppm.
7. The composition of claim 1, where the antifoamant contributes from 1 to 30 ppm of elemental silicon to the fluid.
8. A method for suppressing the formation of foam in a partially synthetic or fully synthetic power transmitting fluid which comprises adding a fluorosilicone polymer to the fluid.

## INTERNATIONAL SEARCH REPORT

National Application No  
PCT/US 96/11737

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 C10M169/04 C10M171/00 //(C10M169/04,101:02,105:36,105:38,  
107:02,129:10,133:12,133:56,155:02),C10N30:18,C10N40:04,C10N60:14

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 C10M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,3 933 659 (R.E.LYLE) 20 January 1976 see column 1, line 10 - line 13 see column 11, line 32 - line 33 see column 12, line 10 - line 14 see column 12, line 41 - line 43 see column 13, line 44 - column 14, line 20	1-8
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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

16 September 1996

Date of mailing of the international search report

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# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 96/11737

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP,A,0 620 267 (IDEMITSU KOSAN COMPANY LIMITED) 19 October 1994 see page 4, line 8 - line 9 see page 4, line 14 - line 15 see page 5, line 53 - line 54 see page 7 - page 8; examples 1-4 ---	1-5
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Information on patent family members

International Application No

PCT/US 96/11737

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